sheds, * * the cultivated will show the steadiest conditions and the best-sustained dry-season flows, but as between cultivated and forested water sheds the forested will produce the best results. * * It follows also that floods will be most severe upon barren areas.'' Hence there exists * * 'the urgent necessity of preserving forests upon slopes, and all areas which are not adapted to agriculture' (p. 348).

Enough has been said to indicate the scope of the volume; which can hardly fail to become a hand-book on the question of water supply. It is probably not too much to say that this report alone is worth more to the State of New Jersey than its geological survey has ever cost. Other States of dense population would do well to follow the example of New Jersey, not only in studying their water resources, but in putting the work under the direction of their geological surveys; for the relation between the geology of a region and the availability of its water supply is so intimate that no other organization is better qualified to direct the work. The U. S. Geological Survey has work of this sort in progress in some parts of the semi-arid regions of the West, from which good results are sure to come.

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John Dalton and the Rise of Modern Chemistry. By SIR HENRY E. ROSCOE. New York and London, Macmillan & Co. 8vo. Pp. 216. Price, $1.25.

It is one of the greatest achievements of modern chemistry to have shown that for each chemical element there is a measurable quantity which, throughout all the transformations that the element undergoes, remains unchanged, and is, therefore, to be regarded as a constant. The laws of definite, multiple and reciprocal proportions of gas volumes and of specific heats, of mass action and of the periodicity of properties, all give converging evidence that for each element there is a definite constant quantity which, in all the changes that the element undergoes, acts like a unit. This constant is the one unchanging, and, therefore, the most characteristic property of the element. The chemical and physical properties of an element, its behavior under different conditions, its possibility of undergoing change under given circumstances, in short its whole character, is dependent upon the magnitude of this constant. A large part of theoretical chemistry is taken up with a consideration of the general methods that are available for the determination of this important quantity, and it is customary to express it by means of a number which indicates its magnitude in terms of the characteristic quantity of some one element, usually hydrogen, taken as a unit. To this number the name Atomic Weight has been given, and to John Dalton, indisputably, belongs the great credit of having first introduced into chemistry the idea of atomic weights. He transformed the Newtonian corpuscular theory of the constitution of bodies into a workable chemical hypothesis, and the subsequent development of his idea, that the atoms of different elements have different constant masses, has given us our present system of atomic weights. But, whether we associate with this term the conception of an atomic constitution of matter or not, the fact remains that these constants stand to-day independent of any hypothesis, and are to be regarded as mathematical quantities that can be deduced from the general laws and principles of the science.

In this book Sir Henry Roscoe has given us a most interesting account of the life and work of the great Manchester chemist. Dalton's life, like that of many scientific workers, was not an eventful one, but he was a man of marked personality, of positive traits of character, and our author has

interwoven a description of the personal characteristics of the man with an account of his scientific work and the incidents of his life in such a way as to make a most attractive and entertaining biography.

From his early years Dalton was accustomed to looking at things from the standpoint of the atomic theory, and throughout his life he remained a firm supporter of this doctrine. Like Newton, he conceived of atoms as 'hard impenetrable, movable particles,' 'incomparably harder than any porous bodies compounded of them, even so very hard as never to wear or break in pieces.' These atoms were supposed to be surrounded with an atmosphere of heat. He has left some drawings which show how he pictured to his mind the structure of the smallest particles of compounds, and in these he foreshadowed the modern constitutional and stereo-chemical formulas. In gases and elastic fluids he considered matter to be in an extreme state of division, and nearly all of his important discoveries resulted from experiments upon gases. It was by considering the constitution of gases that he came to the idea of atomic weights.

Dalton was not as skillful an experimenter as some of his contemporaries; most of his apparatus was made by himself and was often of a very primitive kind. It is remarkable that he should have been able to get the results with it that he did; results that were in most cases confirmed by other workers who used more accurate instruments and more exact methods. Some of the important facts that he discovered were the equal expansibility of different gases under the influence of heat; the practical constancy of the composition of the air, a fact which he established by means of a large number of analyses of air collected at different places and at different altitudes; the law of partial pressures, or that the total pressure of a gas mixture is equal to the sum of the partial pressures of the components, and that in a mixture of gases each component acts like a vacuum to the other components and behaves as though it alone were present. He also investigated the solubility of gases in liquids; but his greatest discovery was the law of multiple proportions. Upon this discovery and upon the fact that he introduced the atomic theory with the idea of atoms of different weights his great fame as a scientific man rests.

Of especial interest in this book is the account here published for the first time of how Dalton arrived at his important conclusion. Among the Dalton papers belonging to the Manchester Literary and Philosophicial Society, Sir Henry Roscoe has found some manuscript notes prepared by Dalton for a course of lectures that he delivered at the Royal Institution in the winter of 1809–10. These notes are printed in full and give an account by Dalton himself how his ideas regarding the atomic theory came to him.

Mentally he was vigorous, independent and self-reliant; he gave little attention to the results obtained by others. Like Newton he reached his conclusions by quiet, steady, continuous thinking. His long life was spent in experimenting and reflecting. It is pleasant to know that in his later years many honors and tokens of esteem came to him from his countrymen and from abroad.

After Dalton the atomic theory was developed and put upon a much broader foundation by Berzelius, and through his work and that of a long line of illustrious successors it has become the central dominant feature of theoretical chemistry.

It is noteworthy that Joule, who did so much to establish the law of the conservation of energy, was a pupil of Dalton, and that the names of both master and pupil are so intimately associated with our two great intellectual instruments of investigating nature, the atomic hypothesis and the theory of energy. The deductions of the

former have the advantage of being readily apprehended, those of the latter of being mathematically exact.

Sir Henry Roscoe deserves the thanks of all workers in chemistry for having provided them with an unusually interesting biography of one of the founders of the science.

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Elasticität und Festigkeit. By C. BACH, Professor in the Technical High School at Stuttgart. Second Edition. Berlin, Julius Springer. 1894. Octavo, 432 pages and xiv plates.

In this work the author lays down the guiding principle that the student of mechanics of materials should first of all become acquainted with the actual phenomena of stress. To this end photographic illustrations are given exhibiting the deformations of bars under tension, of blocks under compression, of beams and plates under flexure and of shafts under torsion. These illustrations are most useful and show the typical changes of form in a beautiful manner. Nevertheless their value is probably not so great as the author assumes, for nearly all the theories and computations of the mechanics of materials are confined to the case where the elastic strength is not exceeded and where changes of form are not perceptible to the eye.

The modulus or coefficient of elasticity, usually represented by the letter E, is not employed in this book. Instead its reciprocal is used and called the extension coefficent, which may be defined as the stretch of a bar per unit of length due to a stress of unity on each square unit of cross section. There can be no doubt but that the term coefficient of elasticity is a most unfortunate one, as it has no relation to elasticity in the ordinary sense of the word, but is a measure of stiffness or rigidity. The improvement desired would be a change of name rather than the introduction of a new term and symbol. Even the author, who uses the new constant consistently in all his formulas, rarely gives numerical values for it, but expresses these in terms of its reciprocal, which is, of course, the coefficient of elasticity as universally employed.

The scope of the work is that of a textbook on the mechanics of materials and of beams, columns and shafts, suitable for technical schools which desire to avoid extended mathematical discussions. The usual theoretic formulas are demonstrated in a neat manner, and many results of tests are presented; those on circular, elliptical and rectangular plates may in particular be noted as novel and valuable. The subject of internal work or resilience is discussed more fully than in British or American books. True internal stresses resulting from the change of shape are properly used in the treatment of cylinders, spheres and plates; owing to the neglect of this precaution, formulas based upon apparent stresses, like those of Rankine, are liable to give values often deviating twenty-five per cent. from the truth.

The formula for the design of columns, long used in the United States under the name of Gordon's formula or Rankine's formula, has not been employed in Germany to the extent that its value demands. The author, however, emphasizes it as an important rule, and gives empirical constants for its use. He also states that the formula was first deduced by Navier; on referring to Navier's works this statement is not found to be justified, it being only mentioned that the stress on the concave side of the column is the sum of the stresses due to direct compression and to lateral flexure, while no formula similar to Gordon's is established.

On the whole, the perusal of the book leaves the impression that the author has